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The Importance of Catfish Burrows in Maintaining Fish Populations of Tropical Freshwater Streams in Western Ecuador

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ABSTRACT

Observations are reported on one of the apparent functions of catfish burrows in rainforest tributaries of western Ecuador. These burrows may provide resident stream fishes with a refuge, or residual habitat, in which they may survive, while conditions in their usual habitat may be too severe to support life. These catfish burrows may also provide points of stream re-population after rainy season conditions restore the physical status of the forest streams or pools to their original full or free-flowing conditions.

INTRODUCTION

During March-April, 1972, August, 1974, and July, 1975 observations were made on the effects of catfish burrows in freshwater tributary streams of the Río Palenque of the Guayas drainage basin in western Ecuador. Catfish burrows are subterranean chambers below the stream bed which are excavated, at least in this case, by *Rhamdia wagneri,* a wide-ranging pimelodid catfish (pers. obs.). Other large pimelodid catfish species found in western Ecuador, such as *Rhamdia cinerascens,* an endemic species, or certain wide-ranging species of *Pimelodella,* may also be involved in the construction of these chambers although no direct evidence presently supports this idea. Various other endemic and sympatric catfish species *(Microglanis variegatus* and *Trichomycterus taenium),* as well as more wide-ranging but still sympatric species *(Pimelodella*

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modestus and *Trichomycterus laticeps),* and other nocturnal non-catfish species *(Sternopygus macrurus,* a wide-ranging gymnotid, and *Gymnotus* sp., an undescribed species of gymnotid) may occupy these burrows on a permenent basis. Evidence to support this statement comes from personal observations which record the above mentioned species moving freely between various catfish chambers and adjacent free-flowing stream or pool areas at various times of the year (both dry and rainy season) when habitation of these burrows would not be considered essential for prolonged existence.

These observations were made concerning the role of these catfish burrows in response to the conditions of the western Ecuadorian dry season, which extends with occasional wet periods from May until early September (See Addenda).

Lowe-McConnell (1964, 1975) has discussed the response of fishes entrapped in isolated pools in Guayana and the overall effects of seasonal cycles on fishes in tropical fresh waters. The present study presents several correlations and parallels to Lowe-McConnell's (1964) study, and provides, in addition, new information concerning the adaptations of these fishes in response to changes in the aquatic habitat brought on by climatic conditions of the dry season.

METHODS AND MATERIALS

All field observations were made at the Centro Cientifico Río Palenque, a national park and biological research station on the Río Palenque, Los Ríos Province, western Ecuador (fig. 1). Although specific statements regarding species associations in catfish burrows are made from one particular collection, general observations and conclusions concerning species associations and/or construction of these burrows were made from my observations on a number of such burrows present in the stream system at Centro Cientifico Río Palenque (fig. 2) during a three-year period (1972-1975). All specimens collected were initially fixed in 10 per cent formalin and later transfered to 70 per cent ethanol. Lengths are given as the standard length (SL) in millimeters. Measurements were made according to Hubbs and Lagler (1958). All measurements were made with dial calipers to the nearest 0.1 mm. All specimens examined are deposited at Field Museum of Natural History (FMNH), Chicago, Illinois.

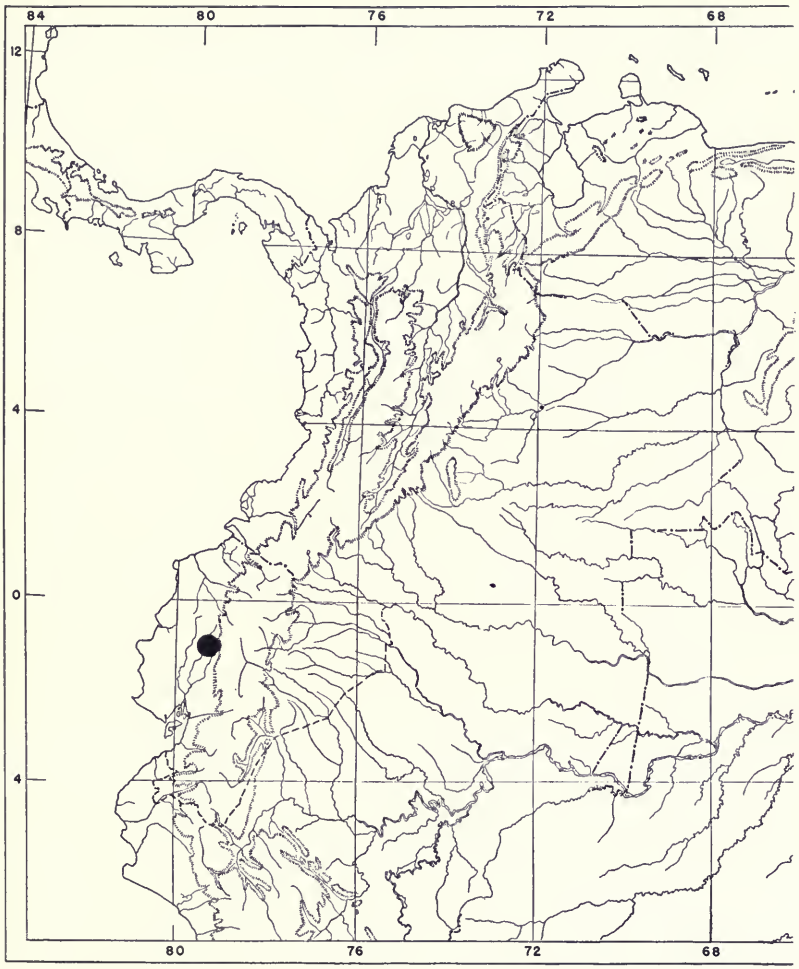

FIG. 1. Location of Centro Cientifico Río Palenque, (●), a national park and biological research station on the Río Palenque of the Guayas drainage basin in western Ecuador.

OBSERVATIONS

Specimens were collected from an isolated forest stream-pool and the adjacent catfish burrow of that pool. The pool was approximately 1 m. long, 30 cm. at its widest point, and 10 cm. at the deepest point. Water temperature in the pool at the time of capture was 31°C (25°C within the catfish burrow). The opening into the catfish

burrow was along the stream bank. The only fish initially present in the main body of the pool were a few small specimens of *Pseudopoecilia fria*, an endemic poeciliid. However, subsequent

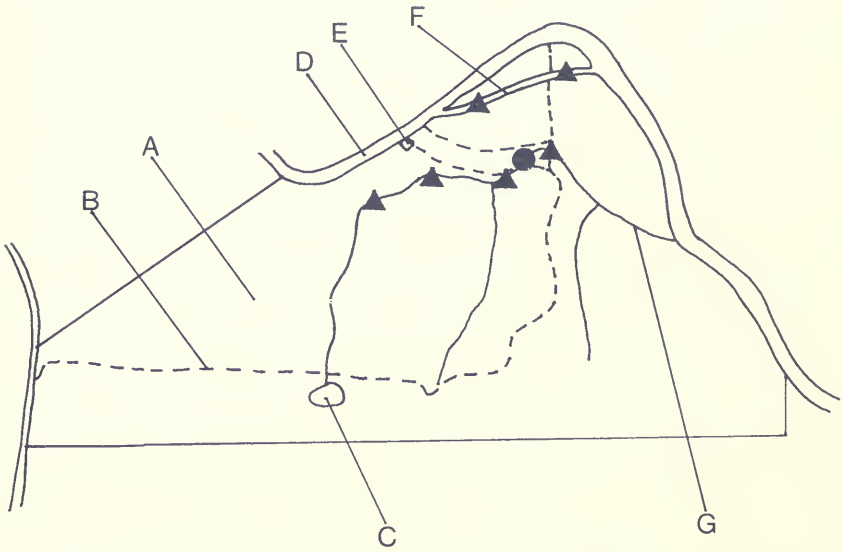

FIG. 2. The small stream system of the Centro Cientifico Río Palenque showing the site at which the specimens discussed in this paper were collected (●), as well as other sites at which observations on catfish burrows have been made by the author (▲). Other symbols are as follows: **A**, Centro Cientifico Río Palenque; **B**, access road from main road; **C**, forest pool (seasonally dry); **D**, Río Palenque; **E**, field station; **F**, small channel off Río Palenque (seasonally active), **G**, small stream system feeding into Río Palenque.

rotenone treatment (mid-afternoon) of the entrance of the catfish burrow yielded 192 fish specimens comprising eight separate families, 12 genera, and 13 species (table 1). Crude probing of the interior of the chamber indicated that the chamber extended below the stream bed to a depth of at least 1 m. Unfortunately, the exact dimensions of the chamber interior could not be determined. Also worthy of mention is the fact that small juveniles, probably young of the year, of two species *(Hoplias microlepis* and *Aequidens rivulatus)* were present in the catfish burrow. During three years of collecting no adult *Hoplias* and only small numbers of adult *Aequidens* have ever been taken from these small streams, since adults of these two species are commonly found in the Río Palenque.

TABLE 1. A listing of the 13 species of fishes collected from the catfish burrow at Centro Cientifico Rio Palenque in western Ecuador, the number of specimens collected, and standard length (SL) range, in millimeters.

Species	no. specimens	SL range
PIMELODIDAE		
Microglanis variegatus	23	16.9-38.7
Pimelodella modestus	3	40.3-55.5
Rhamdia wagneri	25	47.4-193.8
TRICHOMYCTERIDAE		
Trichomycterus laticeps	18	35.1-53.6
Trichomycterus taenium	1	27.5
CHARACIDAE		
Iotabrycon praecox	1	13.5
ERYTHRINIDAE		
Hoplias microlepis	1	30.5
LEBIASINIDAE		
Lebiasina bimaculata	2	45.8-51.9
Piabucina astrigata	2	51.5-102.2
APTERONOTIDAE		
Sternopygus macrurus	14	73.3-194.3
CICHLIDAE		
Aequidens rivulatus	11	13.5-43.4
Cichlasoma ornatum	1	74.7
POECILIIDAE		
Pseudopoecilia fria	90	10.3-39.4
TOTALS	192	

DISCUSSION

The fact that these fishes were able to survive within this catfish burrow is significant in that it may represent an adaptation to a number of severe conditions normally associated with the dry season.

When tropical freshwater fishes are trapped within isolated river or forest pools they may be adversely affected by a number of different biological and physical factors. Decreasing water levels, available oxygen, food supplies, adequate shelter, and increasing temperatures resulting in desiccation, predation, starvation, and suffocation are all critical factors affecting these fishes. The ability of fishes to occupy and survive in a "residual habitat," such as a catfish burrow, may have multiple advantages. The term "residual habitat" is here defined as a type of habitat usually occupied by fishes only during periods of extremely severe environmental stress

when conditions in the fishes' usual or temporary habitats, such as rivers, streams or pools, become unsuitable for prolonged or continued existence. The fact that the fishes collected from this particular catfish burrow would have been able to survive until conditions in the stream or pool improved again to allow normal existence seemed fairly certain since the September rainy season was just beginning, and within a short time the series of isolated and semi-isolated pools in the stream bed was again transformed into its original free-flowing stream condition.

By moving from the more temporary pool habitat to the residual habitat of the catfish burrow these stream-pool fishes are apparently able to alleviate a number of environmental problems. For example, during the late afternoon, water temperatures within the chamber are somewhat cooler than in the adjoining pool. Water temperature of the pool was 31°C, whereas the water temperature of the chamber was 25°C. Predation by birds and land mammals is essentially eliminated for fishes which occupy the chamber, which is not the case for fishes which may become stranded in an open pool.

Two additional, more critical problems which must be contended with are predation from species within the chamber and low oxygen levels. Lowe-McConnell (1964) discusses adaptations of pool-restricted species in Guayana. She suggests that as the available amount of food decreases within the pool the feeding habits of a number of different species will begin to overlap and eventually competition for food may become quite severe. However, she goes on to state that as competition for food becomes more severe the feeding activity in some species will actually decrease and in some cases feeding may cease entirely. There was evidence of this type of behavior during this study as many of the larger catfish and cichlids *(Rhamdia wagneri, Aequidens rivulatus)* which could have easily eaten the smaller cichlids and poeciliids had no food items of any kind contained in their stomachs. If these fishes had indeed ceased to feed, their individual metabolisms would be expected to be lower with a correspondingly lower respiration rate thus conserving available oxygen.

Another important feature of catfish burrows from a community standpoint is that they may serve as a mechanism for stream repopulation of not only adults and sub-adults but of juveniles and possibly young of the year as well. This is evidenced by the capture of small juvenile specimens of *Hoplias microlepis* and *Aequidens rivulatus* mentioned earlier. These isolated and sometimes widely

separated points of stream re-population could prove to be especially important in stream systems above a falls or rapids area where stream re-population could be difficult or impossible from downstream areas.

MATERIAL EXAMINED

One-hundred-ninety-two specimens from one collection. *Aequidens rivulatus* FMNH 79084 (8), 79089 (3); *Cichlasoma ornatum* FMNH 79105 (1); *Hoplias microlepis* FMNH 79054 (1); *Lebiasina bimaculata* FMNH 80699 (2); *Microglanis variegatus* FMNH 79047 (17), 79051 (6); *Piabucina astrigata* FMNH 79043 (2); *Pimelodella modestus* FMNH 83839 (3); *Pseudopoecilia fria* FMNH 79111 (70), 79113 (20); *Rhamdia wagneri* FMNH 79015 (2), 79019 (18), 79200 (5); *Sternopygus macrurus* FMNH 79122 (11), 79125 (3); *Trichomycterus laticeps* FMNH 79129 (6), 79130 (2), 79131 (10); *T. taenium* FMNH 81713 (1); *Iotabrycon praecox* FMNH 83839 (1).

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ADDENDA

During the later half of November, 1978, the author spent two weeks in western Ecuador, during which time additional data was gathered on the effects of catfish burrows on resident stream fishes. During this particular year, the dry season persisted until mid-November. Prior to this time, the lower half of the stream system at the Río Palenque station was completely dry, however, in the upper course small isolated pools of standing water persisted. Two of the

pools in which catfish burrows were present were treated with rotenone several days before the heavy winter rains began and were found to still contain fish.

During the last day of observations on catfish burrows at the Río Palenque station (November 16, 1978) the heavy winter rains began and the stream on the station was transformed into a full free-flowing stream for the first time since mid-summer (June-July). Those fish trapped in the remaining catfish burrows in the upper course of the stream system were able to survive the entire dry season until these winter rains allowed them to repopulate and reinhabit their normal habitat in the stream.